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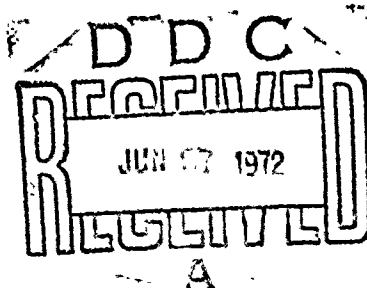
ASD-TR-72-36

COCKPIT COMPATIBILITY EVALUATION RB-57F AND F-4D AIRCRAFT

JOHN R. HOCHWALT

TECHNICAL REPORT ASD-TR-72-36

APRIL 1972



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ASD-TR-72-36

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FOREWORD

This report was prepared by the Crew Support Division, Directorate of Crew and AGE Subsystems Engineering, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio. The work reported herein was performed at the request of the Life Support System Program Office, Aeronautical Systems Division, under the direction of Mrs Lee Rock, ASD/SML, Program Manager.

The author, Mr John R. Hochwalt of the Deputy for Engineering, Aeronautical Systems Division, submitted this report 22 February 1972.

This test program was accomplished through the combined efforts of the Life Support System SPO (ASD/SML); the Crew Equipment Branch (ASD/ENCCE) and the Crew Station Branch (ASD/ENCCS), Crew Support Division, Directorate of Crew and AGE Subsystems Engineering, Aeronautical Systems Division; and the Anthropology Branch (6570 AMRL/HER), Human Engineering Division, 6570 Aerospace Medical Research Laboratories (6570 AMRL/HEA), Aerospace Medical Division.

The following personnel, to whom acknowledgment is hereby made, contributed significantly to the report:

Col Kenneth N. Beers, MC	ASD/SML-6
Mr Kenneth Kennedy	6570 AMRL/HEA
Mr Milton Alexander	6570 AMRL/HEA
Mr Harry Holder	ASD/ENCCS
Mr William Stevens	ASD/SML-6

Special mention is made of the following officers who acted as subjects for this evaluation. Without their outstanding cooperation and dedication, this study would not have been possible.

Col Kenneth N. Beers, MC	ASD/SML-6
L/Col Gene Durden	58WRS, KAFB

FOREWORD (CONTD)

Maj Samuel Van Dyke, Jr	58WRS, KAFB
Capt Karl Bame	58WRS, KAFB
Capt Ernest H. Jones	58WRS, KAFB

The contributions of those maintenance personnel of the 58WRS and the 4900 Test Group, Kirtland Air Force Base, in providing complete support to the above officers, are also gratefully acknowledged.

This technical report has been reviewed and is approved.



GINO P. SANTI
Chief, Crew Support Division
Directorate of Crew and AGE
Subsystems Engineering

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ABSTRACT

The results of a compatibility study performed on the RB-57F and the F-4D aircraft are presented in this report.

Compatibility of crew members with the above aircraft, while wearing an A/P22S-6 flying outfit and other ancillary equipment, was determined.

A 2-1/2 inch thick arctic survival overcoat cushion was found to place the large to extra large crew member above the B-57F aircraft design eye point. A second mockup cushion (with maximum thickness reduced to 1 inch) was found to be satisfactory.

The PCU-15/P torso harness was found to restrict the forward movement of the small to extra small crew member in the RB-57F cockpit.

The A/P22S-6 flying outfit was found to be compatible for use in the F-4D aircraft.

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SECTION I

INTRODUCTION

As a result of a Class IVA Safety Modification Proposal (MIP SANDA 71-0180), installation of a new survival kit and ancillary equipment to replace the outdated equipment presently in use in the RB-57F aircraft has been proposed. Crew members of this aircraft are required to wear a high altitude full pressure flying outfit (A/P22S-2 or A/P22S-6) in the performance of their mission. In order to determine if a compatibility problem exists between crew member and equipment, an in-depth cockpit evaluation was performed at Kirtland Air Force Base, New Mexico. The results of that cockpit evaluation are presented herein.

Modification of two F-4D aircraft to provide a high altitude pressure suit capability resulted in a request to determine the compatibility of the A/P22S-6 flying outfit in the aircraft. This evaluation was also performed at Kirtland Air Force Base, New Mexico in conjunction with the RB-57F compatibility check and the results are presented herein.

SECTION II

FACTUAL DATA

A Class IVA safety modification proposed the following changes to the ancillary equipment in the RB-57F aircraft:

1. Replacement of the present survival kit, Rocket Jet P/N 283000, with a new automatic deployment type survival kit, Rocket Jet P/N 641000- (modified).

2. Replacement of the present NB-9 parachute with the NB-10A parachute.

3. Use of the PCU-15/P torso harness in lieu of the present MA-2P torso harness.

4. Installation of a separate lap belt, P/N MA-6.

5. Incorporation of a sleeping bag (overcoat) within a cushion (designated arctic survival overcoat cushion) and attachment to the survival kit lid. The overall depth of the prototype cushion provided for this compatibility check was 2-1/2 inches at the back, tapering to 1/2 inch at the front.

Compatibility of the above equipment with crew members outfitted in the full pressure suit assembly (A/P22S-6) was determined at Kirtland AFB. Those participating in this program are mentioned in the attendees list, Appendix I.

Crew members from the 58WRS volunteered as test subjects for both the RB-57F and the F-4D aircraft. From these were selected subjects approximating the 5th percentile (small) and the 95th percentile (large) of the USAF population, and additional subjects in the medium category. The anthropometrical nude measurements of these crew members are given

in Appendix II and were taken in accordance with the techniques expressed in WADC TR 52-321, Anthropometry of Flying Personnel - 1950, H. T. Herzberg and G. S. Daniels.

Two RB-57F aircraft were provided, side-by-side, with the ejection seats and canopy of one aircraft capable of being electrically raised and lowered to permit measurements of test subjects during simulated normal flying. The second aircraft was provided with canopy removed and a crane in position to raise and lower the ejection seat through the ejection sequence. Each aircraft was equipped with the McDonnell Douglas Corporation ESCAPAC 1C-6 Ejection Seat System. Measurements showing the ejection clearances in the fore and aft cockpits were taken and are given in Appendix III.

The test plan called for the following:

1. Test subject placed in front cockpit of electrically powered aircraft and studies and measurements taken with A/P22S-6 outfit uninflated, then inflated to 2.75 PSI (nominal 70,000 feet).
2. Transfer of subject to rear cockpit and tests repeated.
3. Transfer of subject to second aircraft with studies and measurements taken through the ejection sequence with outfit uninflated, then inflated to 2.75 PSI.

Similar procedures were followed with the F-4 aircraft with the exception that one aircraft was provided. Upon completion, therefore, of studies involving raising and lowering the ejection seats and canopy, the F-4 canopies were removed and the ejection sequence studied. The cockpit ejection clearance dimensions of the F-4D aircraft are as shown in Appendix IV of this report. Aircraft and personnel equipment consisted of the following:

1. The Martin Baker H7 Ejection Seat
2. Bendix Seat Kit

3. A/P22S-6 Full Outfit
4. PCU-3/P Parachute Harness
5. LPU-10/P Underarm Life Preserver
6. Martin Baker F-4 Parachute

Observations and comments during the test are contained in Appendix V.

Personnel from the 442^d CCTS, MacDill AFB (TAC) stated their dissatisfaction with the survival kit and NB-10A parachute installed in the B-57G aircraft by TO 1B-57G-505. The riser attachment to the PCU-15/P harness limits forward mobility such that the short crew member is unable to reach the lower fuel panel. On long flight missions, back pain is attributed to the cushion installed on the survival kit.

NOTE: It is understood that the following actions are being taken by SAAMA and WRAMA as a result of the compatibility study:

1. SAAMA/MMDTA will recommend production of 130 each Rocket Jet P/N 641000 survival kits on contract with Rocket Jet be held in abeyance pending results of ASD study.
2. Delay forwarding of SAAMA purchase request to OCAMA for procurement of the 641000 survival kits for RB-57F retrofit program pending completion of ASD study.
3. SAAMA/MMDTA will continue study to determine corrective action concerning short parachute risers on the NB-10A parachute which restrict crew member forward mobility.
4. WRAMA/MMHO will take action to direct the 1st TAC Fighter Wing to remove parachutes and survival kits installed by TO 1B-57G-505 and reinstall the NB-9 parachute and 283000 survival kits.

SECTION III

CONCLUSIONS

The original prototype (2-1/2 inch thickness) arctic survival overcoat cushion placed the eye level of the large to extra large crew member above the B-57F aircraft design eye point. The second mockup cushion (1 inch thickness) was satisfactory.

The manner of attachment of the NB-10A parachute to the PCU-15/P torso harness restricts forward movement of the crew member. In the case of the small to extra small crew member, this restriction results in inability to reach the lower and main instrument panels.

The A/P22S-6 flying outfit is compatible for use with the F-4D aircraft for those individual body sizes tested in accordance with the conditions noted herein.

SECTION IV
RECOMMENDATIONS

1. It is recommended that the survival kit cushion with arctic survival overcoat be redesigned to be compatible with optimum crew member eye level adjustability. The cushion(s) shall be suitable for testing on both part numbers 283000 and 641000 survival kits.
2. It is recommended that the redesigned survival kit configuration be flight tested on long duration flight missions.
3. It is recommended that the redesign of the P/N 641000 survival kit to a lower angle of lid be studied dependent upon the results obtained in 1 above.
4. It is recommended that the A/P22S-6 flying outfit be certified for use in the F-4D aircraft with the understanding that each crew member fitted in a pressure suit be required to be thoroughly checked out in the aircraft cockpit with the outfit inflated and uninflated to determine that all normal functions, reach requirements, motion requirements, etc., can be accomplished for normal mission situations. In addition, the ejection seat should be raised and lowered on the ejection rails with the outfit inflated to the maximum pressure commensurate with the anticipated maximum altitude of the aircraft. Any indication of an ejection clearance problem should be justification for restricting the aircrewmembers from flying under the conditions where the problem exists.

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APPENDIX I

LIST OF ATTENDEES

ASD-TR-72-36

<u>Name</u>	<u>Location</u>	<u>Extension</u>
L/Col Thomas J. O'Malley	4900 Test Group/FTOF/ Kirtland AFB	
L/Col Robert J. Vanden-Heuvel	4900 Test Group/KAFB	2955/3060
Capt H. C. Thompson	4900 Test Group/FTOF	2955
SMSgt James A. Hurst	4900 Flight Test/KAFB	2060
Major Kolman	58 DOLS, KAFB	3522
Capt Ernest A. Jones	58 DOLS, KAFB	
Capt (Dr) Barnett	58WRS/Flight Medicine/ KAFB	
SMSgt R. G. Dugan	58WRS/Maint/KAFB	2340
MSgt D. Kutulis	58WRS/MAQ/KAFB	2763
SSgt R. Beltran	58WRS/Egress/KAFB	3071
Mr P. E. Pruett	4925 FMS/KAFB	3112
Major Billy G. Edenfield	WRAMA/MMHO-5 B57 System Manager	3756
Mr Robert T. Hudman	WRAMA/MMHTA	2853
Mr W. R. Swedenburg	WRAMA/MMEAP	3593
Capt Barr	4424CCTS McDill (TAC)	3604
MSgt Richard C. Manning	MAC/DOTOL, Scott AFB	5696
SSgt George L. Tash	MAC/DOTOL, Scott AFB	3625/4745
Mr P. H. Mosier	OCAMA/MMNTD	735-7355
Mr J. C. Smith	SAAMA/MMFA	57561
Mr W. J. Brient	SAAMA/MMDTA	53124
MSgt Robert T. Dutka	USAF Hosp (PTF), Tyndall AFB, Fla	2947
Mr Kenneth W. Kennedy	6570 AMRL/HEA (Anthropology Br)	513-255- 5770
Mr Milton Alexander	6570 AMRL/HEA, WPAFB	53368/ 55770

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<u>Name</u>	<u>Location</u>	<u>Extension</u>
Col Ken N. Beers	ASD/SML (Med) Life Support SPO	53676
Mr W. E. Stevens	ASD/SML-6, WPAFB	53676
Mr H. W. Holder	ASD/ENCCS, WPAFB	55160
Mr John Hochwalt	ASD/ENCCE, WPAFB	53349
Mr J. L. Parris	Convair, Ft Worth, Texas	4100
Mr B. J. Lynn	Convair, Ft Worth, Texas	2045
Mr B. Nichols, Jr	Douglas Aircraft Co Long Beach, California	213-593- 3275
Mr John T. Soja	American Safety Flight Systems Inc Rocket Jet/ ARO Division	213-245- 6421
Mr Klaas Hendricks	Rocket Jet/ARO Division	213-245- 6421
Mr Art Till	Rocket Jet/ARO Division	714-794- 3019

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APPENDIX II

NUDE MEASUREMENTS

NUDE MEASUREMENTS

Name	Durden, Gene
Flight Function	Pilot, RB-57F Front Cockpit
Rank	L/Col
Serial No.	264-34-7254
Age	41

	Value	Percentile
Height	73.75	94th %
Weight	220.	97th
Functional Reach	33.85	92nd
Sitting Height	39.7	99th
Eye Height (S)	33.25	88th
Acromial Height (S)	26.7	99th
Thigh Height (S)	6.5	50th
Knee Height (S)	23.4	92nd
Popliteal Height (S)	20.0	99th
Buttock-Knee Length (S)	25.15	90th
Buttock - Popliteal Length (S)	20.7	80th
Hip Breadth (S)	15.65	80th
Shoulder Breadth (S)	21.1	97th

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Name Beers, Ken
Flight Function ---
Rank Col
Serial No. ---
Age 41

	Value	Percentile
Height	64.8	3rd %
Weight	142.5	6th
Functional Reach	30.6	25th
Sitting Height	33.25	12th
Eye Height (S)	29.0	1st
Acromial Height (S)	22.35	8th
Thigh Height (S)	5.25	1st
Knee Height (S)	20.15	4th
Popliteal Height (S)	16.45	20th
Buttock - Knee Length (S)	23.15	25th
Buttock - Popliteal Length (S)	19.3	30th
Hip Breadth (S)	12.8	1st
Shoulder Breadth (S)	17.25	3rd

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Name VanDyke, Samuel Jr.
 Flight Function Pilot, RB-57F Front Cockpit
 Rank Maj
 Serial No. 527-26-6137
 Age 41

	Value	Percentile
Height	70.9	67th %
Weight	200.	89th
Functional Reach	33.1	85th
Sitting Height	38.15	88th
Eye Height (S)	34.1	96th
Acromial Height (S)	25.5	90th
Thigh Height (S)	6.75	65th
Knee Height (S)	22.15	60th
Popliteal Height (S)	16.95	35th
Buttock - Knee Length (S)	24.1	64th
Buttock - Popliteal Length (S)	19.8	50th
Hip Breadth (S)	14.75	50th
Shoulder Breadth (S)	20.9	97th

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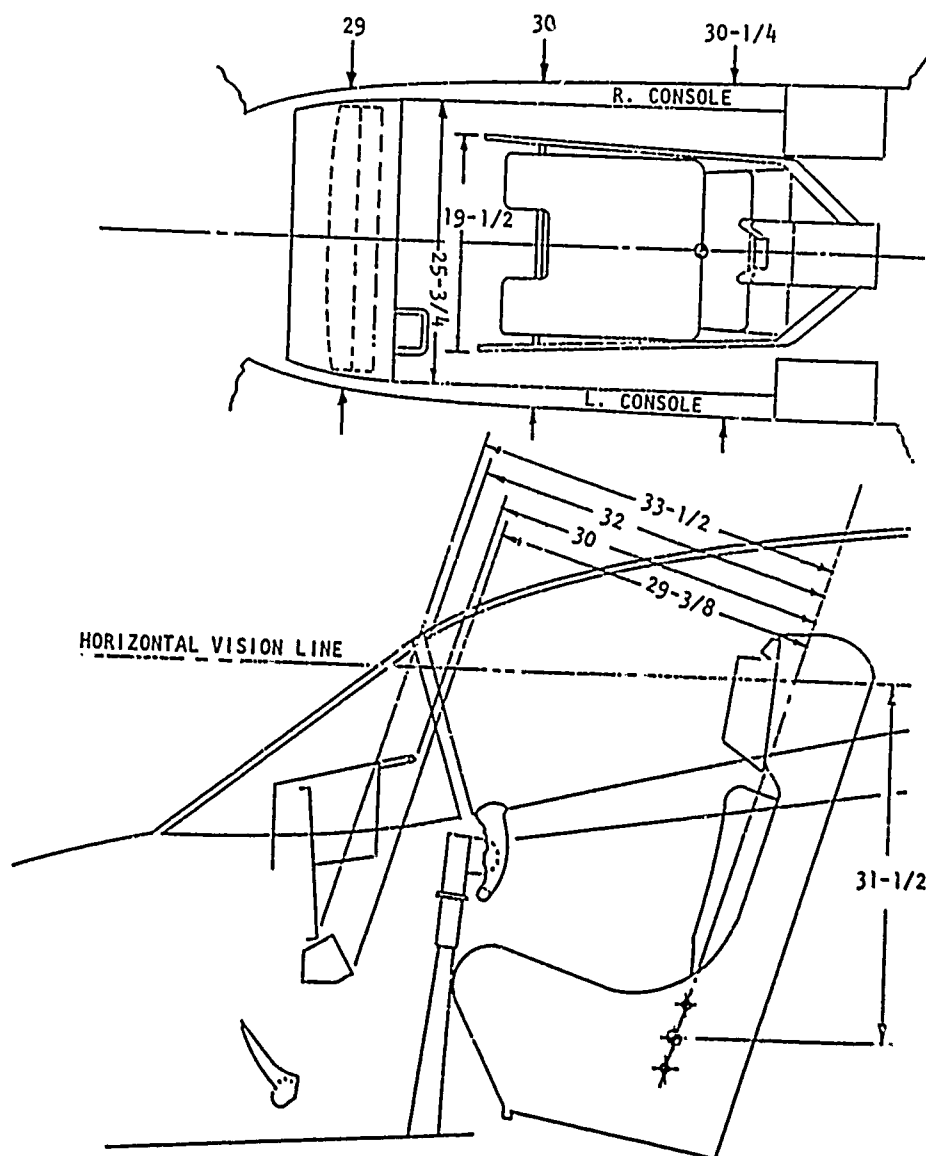
Name Bame, Karl
Flight Function Pilot, RB-57F Front Cockpit
Rank Capt
Serial No. 270-32-3629
Age 29

	Value	Percentile
Height	66.85	11th %
Weight	141.	6th
Functional Reach	30.4	24th
Sitting Height	35.2	11th
Eye Height (S)	30.4	10th
Acromial Height (S)	24.25	60th
Thigh Height (S)	5.65	6th
Knee Height (S)	21.05	17th
Popliteal Height (S)	17.7	74th
Buttock-Knee Length (S)	21.95	4th
Buttock - Popliteal Length (S)	18.4	9th
Hip Breadth (S)	13.65	7th
Shoulder Breadth (S)	18.5	32nd

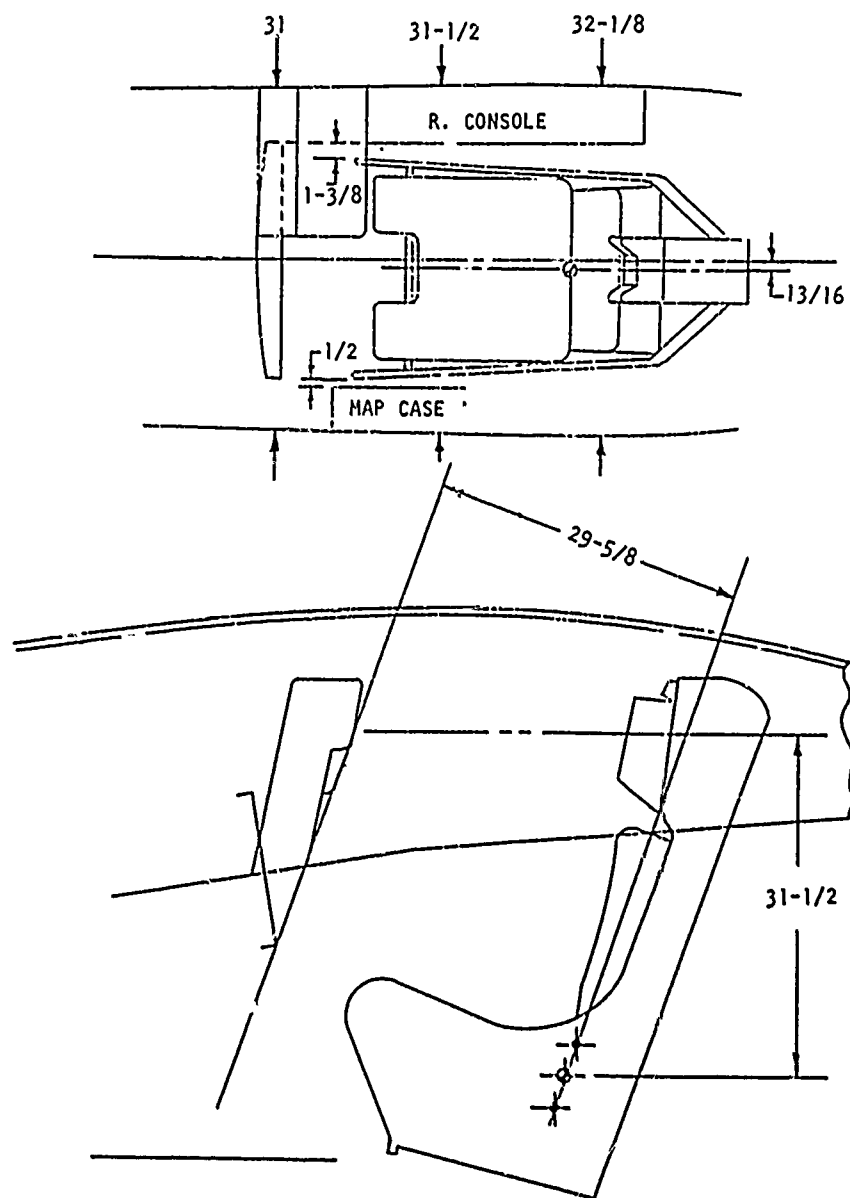
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APPENDIX III

COCKPIT EJECTION CLEARANCES
B-57 AIRCRAFT



Fwd Cockpit Ejection Clearance B-57F

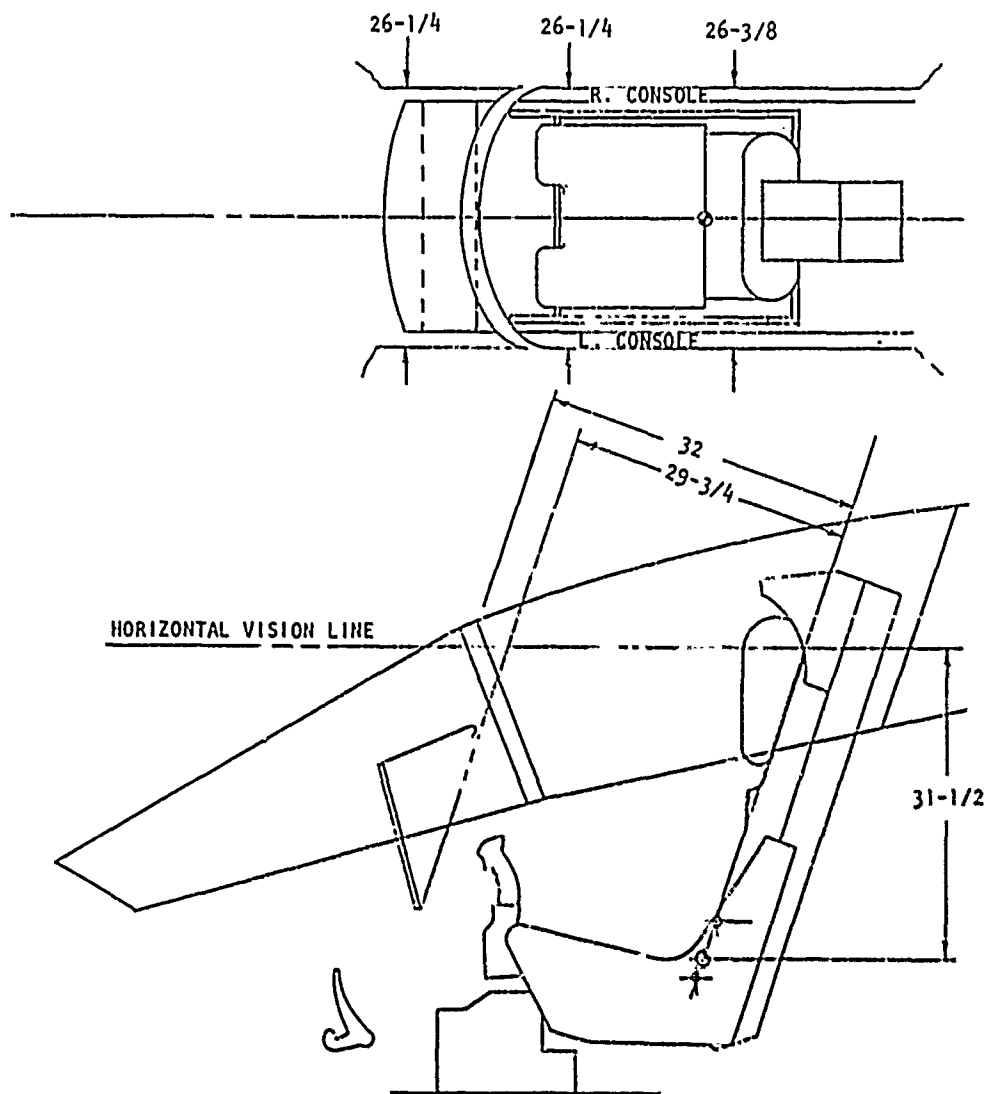


Aft Cockpit Ejection Clearance B-57F

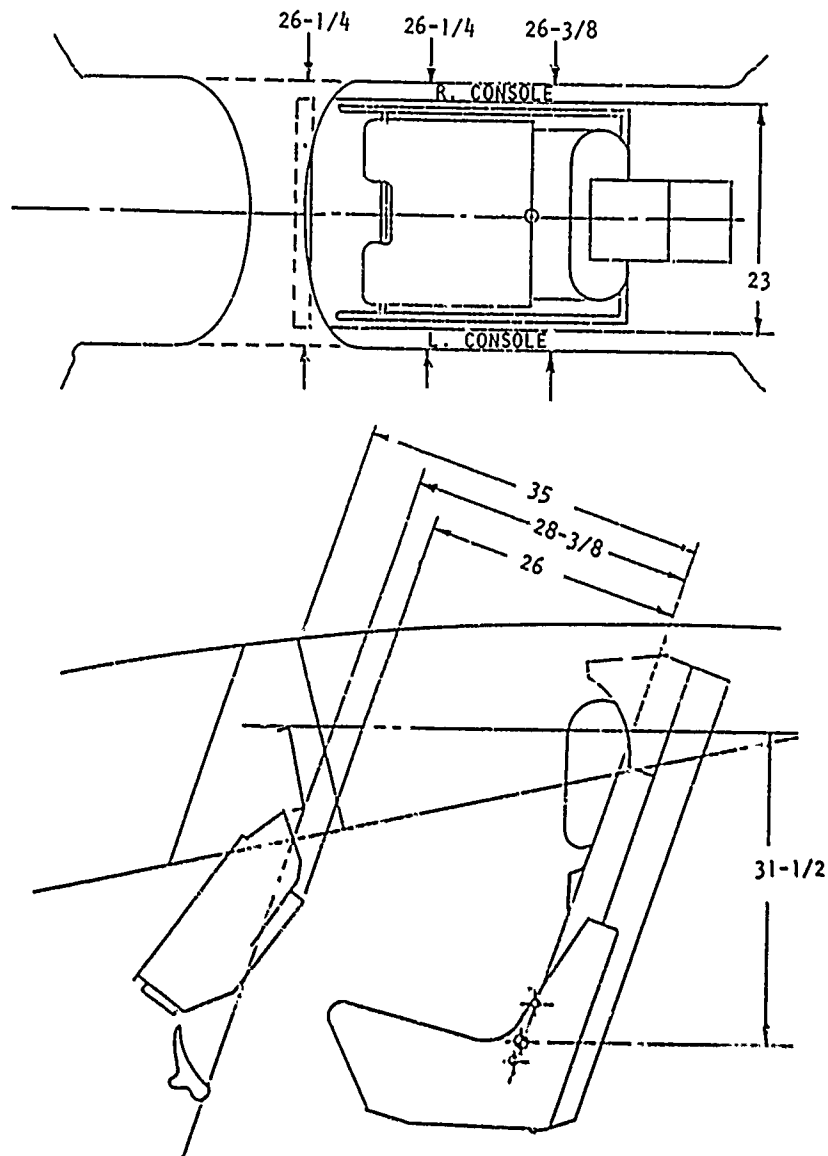
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APPENDIX IV

COCKPIT EJECTION CLEARANCES
F-4D AIRCRAFT



Fwd Cockpit Ejection Clearance F-40



Aft Cockpit Ejection Clearance F-40

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APPENDIX V

OBSERVATIONS AND COMMENTS
DURING TESTS

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OBSERVATIONS AND COMMENTS DURING TESTS - RB-57F AIRCRAFT

L/Col Durden - Large Long A/P22S-6 Flying Outfit

Front Seat

a. Outfit uninflated - test subject (sitting height 39.7 inches - 99th percentile; sitting eye height 33.25 inches - 88th percentile), with the seat full down, was above the aircraft design eye point and looking directly into the standby compass and canopy bow.

b. Outfit inflated to 2.75 PSI - subject able to reach all controls, left and right consoles, main and lower instrument panels. Egress handle used when reaching forward instrumentation with right hand. Two fingers and thumb of each hand on ejection handle.

c. Ejection mode, outfit inflated to 2.75 PSI - left and right knee clearance to top edge of canopy, 3-1/2 inches. Foot clearance, adequate. Elbow to canopy sill clearance, left and right, 1-3/4 inches.

Back Seat - Ejection mode, outfit inflated to 2.75 PSI - left knee clearance to lower panel, 1-3/4 inches. Right knee clearance to auxiliary panel on glare shield, 1-1/2 inches. Elbow to canopy sill clearance, left and right, 4 inches. One finger and thumb of each hand on ejection handle.

Col Beers - Small Long A/P22S-6 Flying Outfit. (This outfit was provided the test subject by the 58WRS. The size weight chart (Table 2-1, TO 14P3-6-111) states that the correct size for Colonel Beers is Small Short. This size was not available, however.)

Front Seat

a. Outfit uninflated - test subject (sitting height 64.8 inches - 3rd percentile; sitting eye height 33.25 inches - 12th percentile) achieved optimum eye level with the seat in the neutral position. Subject able to reach all necessary controls and instrumentation.

b. Outfit inflated to 2.75 PSI - subject able to reach all controls and instrumentation on left and right console. Subject unable to reach main and lower instrument panel due to short parachute risers on NB-10A parachute, and possible restrictions imposed by the improperly sized full pressure outfit. Knee and elbow clearance good.

The following RB-57F compatibility studies were accomplished substituting a 1-inch thick seat cushion (simulated by means of a 1-inch block), for the 2-1/2 inch thick arctic survival overcoat cushion, for the purpose of achieving an optimum eye level for the large to extra large crew member.

Major VanDyke, Jr - Large Regular A/P22S6 Flying Outfit

Front Seat

a. Outfit uninflated - test subject (sitting height 38.15 inches - 88th percentile; sitting height 34.1 inches - 96th percentile) achieved optimum eye level with seat full down during simulated takeoff and seat in neutral position during simulated normal flight. Subject able to reach all necessary controls and instrumentation.

b. Outfit inflated to 2.75 PSI - with seat in neutral position and left hand on egress handle, subject able to reach right console and main and lower instrument panel with right hand. Subject able to reach left console, main and lower panel instrumentation with left hand by lowering the seat to the full down position. Three fingers and thumb of each hand on ejection handle. Arm and knee clearance good.

Back Seat

Outfit inflated to 2.75 PSI - arm and knee clearance good. Subject able to reach all instrumentation. Subject in normal flight position with seat adjusted to 3/4 inch below neutral.

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Capt Bame - Small Long A/P22S-6 Flying Outfit

Front Seat

a. Outfit uninflated - test subject (sitting height 35.2 inches - 11th percentile; sitting eye height 30.4 inches - 10th percentile) achieved optimum eye level with seat adjusted to 1/4 inch above neutral. Access to all controls and instrumentation good. Two fingers and thumb of each hand on ejection handle using crossover grip.

b. Outfit inflated to 2.75 PSI - access to all controls good. Using egress handle and seat full down, subject able to reach right hand console, main and lower instrument panels with right hand. Subject able to reach left console with left hand but not able to reach lower and main panel with left hand. Two fingers and thumb of each hand on ejection handle.

OBSERVATIONS AND COMMENTS DURING TESTS - F-4 AIRCRAFT

Capt Bame - Small Long A/P22S-6 Flying Outfit

Front Seat - Subject achieved optimum eye level with seat located 1 inch below neutral. Access to all controls and instrumentation good with outfit uninflated and inflated. Knee and elbow clearance good.

Back Seat - Access to all controls and instrumentation good with outfit uninflated and inflated. Knee and elbow clearance good.

Major Van Dyke, Jr - Large Regular A/P22S-6 Flying Outfit

Front Seat

a. Subject achieved optimum eye level with seat located 2 inches below neutral point. Access to all controls and instrumentation good with outfit inflated and uninflated.

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b. Ejection Mode - outfit inflated to 2.75 PSI - elbow to canopy sill clearance 1/4 inch both sides. Knee clearance to windscreen 5 inches, left and right. Two fingers and thumb of each hand on ejection handle.

Back Seat - Same as above due to similar configuration.

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13. ABSTRACT <p>The results of a compatibility study performed on the RB-57F and the F-4D aircraft are presented in this report.</p> <p>Compatibility of crew members with the above aircraft, while wearing an A/P22S-6 flying outfit and other ancillary equipment, was determined.</p> <p>A 2-1/2 inch thick arctic survival overcoat cushion was found to place the large to extra large crew member above the B-57F aircraft design eye point. A second mockup cushion (with maximum thickness reduced to 1 inch) was found to be satisfactory.</p> <p>The PCU-15/P torso harness was found to restrict the forward movement of the small to extra small crew member in the RB-57B cockpit.</p> <p>The A/P22S-6 flying outfit was found to be compatible for use in the F-4D aircraft.</p>		

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Cockpit Compatibility Evaluation RB-57F F-4D A/P22S-6 Flying Outfit Arctic Survival Overcoat Cushion Automatic Deployment Type Survival Kit						

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